Warmup!

Sketch a polynomial graph (in secret) and have a neighbor ask yes/no questions to figure it out!

18. $a^5 + 6a^4 + 5a^3 = 0$

$a^3(a^2 + 6a + 5) = 0$

$a=0$, $a=0$, $a=0$ $\quad (a+5)(a+1) = 0$

$a = -5 \quad a = -1$

19. $b^4 = 9$

$b^4 - 9 = 0$

$(b^2+3)(b^2-3) = 0$

$b^2 = -3 \quad b^2 = 3$

$b = \pm i\sqrt{3} \quad b = \pm\sqrt{3}$

20 $t^5 - 256t = 0$

$t(t^4 - 256) = 0$

$t=0 \quad (t^2+16)(t^2-16) = 0$

$t^2 = -16$

$t = \pm 4i \quad t = \pm 4$

7-4 Remainder and Factor Theorems

Solve.
$x^3 + 4x^2 - 15x - 18 = 0$
If x - 3 is a factor.

$$\begin{array}{r|rrrr} 3 & 1 & 4 & -15 & -18 \\ & & 3 & 21 & 18 \\ \hline & 1 & 7 & 6 & 0 \end{array}$$

$x^2 + 7x + 6 = 0$

$(x+6)(x+1)$

$x=3 \quad x=-6 \quad x=-1$

$\{-6, -1, 3\}$

Solve.
$x^3 + 7x^2 + 2x - 40 = 0$
If x - 2 is a factor.

$$\begin{array}{r|rrrr} 2 & 1 & 7 & 2 & -40 \\ & & 2 & 18 & 40 \\ \hline & 1 & 9 & 20 & 0 \end{array}$$

$x^2 + 9x + 20 = 0$

$(x+5)(x+4)$

$\{-5, -4, 2\}$

Solve.
$x^3 - 2x^2 + 9x - 18 = 0$
If x - 2 is a factor.

$$\begin{array}{r|rrrr} 2 & 1 & -2 & 9 & -18 \\ & & 2 & 0 & 18 \\ \hline & 1 & 0 & 9 & 0 \end{array}$$

$x^2 + 9 = 0$

$x^2 = -9$

$x = \pm 3i$

$\{2, \pm 3i\}$

When it is a factor, what can you say about the remainder?

Is it a factor?

$f(x) = x^3 + x^2 + 3x + 3$
Is x + 2 a factor?

$$\begin{array}{r|rrrr} -2 & 1 & 1 & 3 & 3 \\ & & -2 & 2 & -10 \\ \hline & 1 & -1 & 5 & -7 \end{array}$$

No

$f(x) = x^3 + x^2 + 3x + 3$
Find f(-2).

$f(-2) = (-2)^3 + (-2)^2 + 3(-2) + 3$

$-8 + 4 - 6 + 3$

$f(-2) = -7$

$f(x) = x^3 + x^2 + 3x + 3$
Is x + 3 a factor?

$$\begin{array}{r|rrrr} -3 & 1 & 1 & 3 & 3 \\ & & -3 & 6 & -27 \\ \hline & 1 & -2 & 9 & -24 \end{array}$$

No

$f(x) = x^3 + x^2 + 3x + 3$
Is x + 1 a factor?

$$\begin{array}{r|rrrr} -1 & 1 & 1 & 3 & 3 \\ & & -1 & 0 & -3 \\ \hline & 1 & 0 & 3 & 0 \end{array}$$

yes

Find k such that
$2x^4 + x^3 + 5x^2 - 6x + k \div x + 2$ has a remainder of 5.

$$\begin{array}{r|rrrrr} -2 & 2 & 1 & 5 & -6 & k \\ & & -4 & 6 & -22 & 56 \\ \hline & 2 & -3 & 11 & -28 & k+56 \end{array}$$

$k + 56 = 5$

$k = -51$

$2x^4 + x^3 + 5x^2 - 6x + k$
Find k such that x + 2 is a factor.

$R = k + 56 = 0$

$\boxed{k = -56}$

Remainder Theorem (summary)
The remainder of $f(x) \div (x - a)$ is $f(a)$.

Factor Theorem (summary)
The binomial $(x - a)$ is a factor of $f(x)$ iff $f(a) = 0$.

if and only if

$f(x) = 3x^4 - 2x^3 + x^2 - 2$

$\cancel{f(4)} =$

$$\begin{array}{r|rrrrr} 2 & 3 & -2 & 1 & 0 & -2 \\ & & 6 & 8 & 18 & 36 \\ \hline & 3 & 4 & 9 & 18 & 34 \end{array}$$

$f(2) = 34$

HW
p368-369
13-17, 21-27, 31-35 all odds